CONTRIBUTIONS FROM THE LABORATORY OF VERTEBRATE BIOLOGY

UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN

NUMBER 37 MAY, 1947

VARIATION IN SHADE OF PELAGE OF LOCAL POPULATIONS OF THE CACTUS-MOUSE (*PEROMYSCUS EREMICUS*) IN THE TULAROSA BASIN AND ADJACENT AREAS OF SOUTHERN NEW MEXICO

BY W. FRANK BLAIR

Accepted for publication July 19, 1946

CONTENTS

Introduction 1
Acknowledgments 1
Methods of Study 1
Collecting Stations 2
Soil Colors 4
Shade of Pelage Color 4
Discussion 5
Summary 6
Literature Cited 6

INTRODUCTION

THE soils on which cactus-mice (*Peromyscus eremicus*) live in the Tularosa Basin, New Mexico, exhibit extremes in shade of color within a relatively small area. Stocks of cactus-mice were collected in 1938 and 1940 as part of a study of color variation in the mammals of this area. These stocks afford an opportunity to study the relation of shade of soil color to the shade of pelage color of local, slightly isolated populations of cactus-mice.

ACKNOWLEDGMENTS

This study was supported by the Laboratory of Vertebrate Biology, University of Michigan. The 1938 expedition, on which a part of the stocks were obtained, was supported in part by a grant to Lee R. Dice from the Carnegie Institution of Washington. The 1940 expedition, on which other stocks were collected, was supported in part by a grant from the Horace H. Rackham School of Graduate Studies of the University of Michigan. The color readings were made by S. L. Bellanca, D. M. Clarke, C. W. McCollum, W. F. McNally, and myself. The statistical calculations were made by D. M. Clarke, Bruce Kirchenbaum, and myself.

METHODS OF STUDY

The cactus-mice taken in the field were shipped alive to the Laboratory of Vertebrate Biology at the University of Michigan in Ann Arbor. All of the mice were kept under standard conditions and were fed a standard ration. The laboratory-born offspring of these field-caught animals were raised to an age of twenty-two or more weeks, at which time they had attained adult pelage. Then they were killed and prepared as flat skins. The shade of color of the skins was measured by use of the Ives tint photometer, using the methods described by Dice (1932). As the shade of pelage color only was to be measured, tint photometer readings on the skins were made with only the red filter.

COLLECTING STATIONS

Cactus-mice were collected on two lava beds in and near the Tularosa Basin and from three stations on the sandy desert of the same basin (Map 1). These stations are described as follows:

Alamogordo. About three miles south of the town of Alamogordo, and about two miles west of the foothills of the Sacramento Mountains. Three females and six males were trapped in mesquite association. The soil is pinkish gray in color, and there are no rocks in this area.

TABLE I

SHADE OF SOILS INHABITED, AS SHOWN BY MEANS OF TEN TINT PHOTOMETER READINGS WITH RED FILTER ON EACH SAMPLE

Shade of Pelage of Adult Cactus-mice (*Peromyscus eremicus*), Standard Deviations, with Standard Errors.

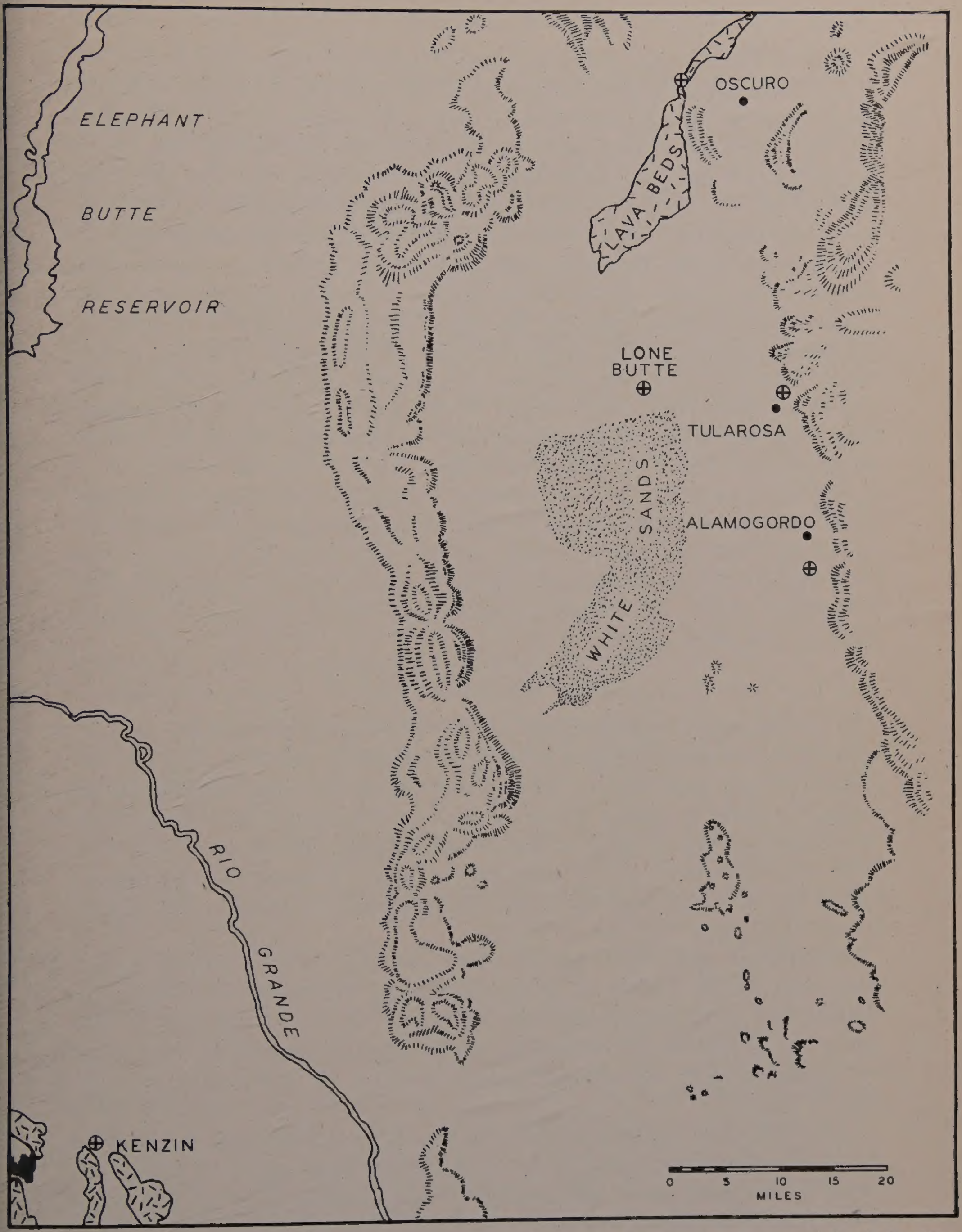
Stock	Shade of Soil Color	Specimens			
		Number Parents	Number Specimens	Means	Standard Deviations
Tularosa	12.3	9	42	14.52 ± 0.62	3.99 ± 0.44
Lone Butte	36.0	9	49	16.98 ± 0.35	2.42 ± 0.24
Oscuro	10.3	6	88	10.94 ± 0.24	2.21 ± 0.17
Kenzin	12.4	7	69	9.90 ± 0.25	2.07 ± 0.18
Alamogordo	19.6	9	39	17.80 ± 0.30	1.86 ± 0.21

Lone Butte. About thirteen miles west of Tularosa in a small, isolated area of mesquite association. Four females and five males were taken here. The soil is pale pinkish gray, and there are no rocks.

Tularosa. Three miles north of Tularosa, and about two miles west of the foothills of the mountains. Four females and five males were captured in grassy wash association. The soil is dark red, and there are no rocks.

Oscuro. The Tularosa Malpais about five miles west of Oscuro. Three males and three females were collected in Malpais lava association. The mice were living in crevices and holes in the black lava.

Kenzin. Lava bed at Kenzin, Dona Ana County. Three females and four males were obtained on the lava bed. The lava at this station is not quite as dark as the Tularosa Malpais lava (Table I).



MAP 1. Tularosa Basin and adjoining areas in southern New Mexico, showing approximate location of stations at which cactus-mice were collected. Crossed circles indicate collecting stations.

SOIL COLORS

The two lava beds studied are composed of dark rock. The lava of the Tularosa Malpais is slightly darker than that of the Kenzin bed (Table I). Small quantities of soil paler than the lava rock have accumulated in pockets on both lava beds. This is particularly true of the Kenzin bed, where pale, orange-colored sand has been blown on the flattest part of the lava from near-by dunes. The cactus-mice live in crevices in the lava, but they undoubtedly travel over the pockets of soil as well as over the rough rock.

The soils of the Tularosa Basin are highly variable in shade. The creamy white gypsum of the White Sands, an area of approximately 270 square miles near the center of the basin, is the palest soil of the region. Pinkish gray soils, which occur over most of the basin, exclusive of the White Sands, are pale, but they do not approach the White Sands in this respect. Cactus-mice were collected at two stations on these pinkish gray soils. The soil at the Lone Butte station was paler than that at the Alamogordo station (Table I). An area of dark red soil occupies about twenty square miles of the desert just north of the town of Tularosa. This soil, while very different in hue, is as dark as the Kenzin lava. A stock of cactus-mice was taken on this dark, red soil. The soils in the foothills of the mountains along the eastern edge of the basin, are predominantly pale and pinkish gray. The Tularosa dark red soil extends for an undetermined distance into the foothills.

SHADE OF PELAGE COLOR

The colorimetric measurements of the field-caught and laboratory-raised cactus-mice are roughly indicative of the variation in shade of pelage in the respective wild populations. The parameters of the wild populations in respect to shade of pelage obviously cannot be estimated accurately from these data, for the numbers of field-caught parents are too small to afford fully reliable samples of the wild populations. Nevertheless, the laboratory stocks suffice to show the major trends in shade of pelage in the populations from which they were derived.

The Kenzin and Oscuro stocks, which are from dark lava beds, do not differ very greatly in shade of pelage (Table I). The Oscuro stock averages slightly, but significantly, paler than the Kenzin stock, the difference in the means is 1.04 ± 0.35 tint photometer units, which is significant. The lava-bed stocks are both significantly darker than any of the stocks from the desert plain.

The Tularosa stock, originating from a small area of dark red soil as dark in shade as the Kenzin lava, is intermediate in mean shade of pelage between the lava-bed stocks and the stocks from relatively pale, pinkish gray soils. The Tularosa stock is significantly paler than the lava-bed stocks and significantly darker than the Alamogordo and Lone Butte mice. The Tularosa stock is also significantly more variable, as shown by the standard deviations, than any of the other stock studied (Table I). The palest Tularosa animals are as pale as the palest of those from the other desert plain stocks, and the darkest approach the darkest of the lava-bed mice in depth of shade.

The Alamogordo and Lone Butte stocks, which are from relatively pale desert soils, are significantly paler than the three other stocks (Table I). There is no significant difference between these two stocks in mean shade of pelage, nor in variability, as shown by the standard deviations.

DISCUSSION

The tendency of desert mammals in general and of cactus-mice in particular to be inconspicuous on their backgrounds has been pointed out by Dice and Blossom (1932) and by Dice (1939). This tendency is evident in the cactus-mice of the Tularosa Basin, for they usually correspond in shade of pelage to that of the background on which they live. The soils of the basin form a mosaic of markedly different shades of color. The aggregate population of cactus-mice in the region, in turn, is a mosaic of a number of small, local populations that differ in shade of pelage. Local populations of similar shades of pelage occur on soils of similar shade many miles apart. Intervening areas of differently colored soils support populations with different shades of pelage. Thus, the dark races on the two widely separated, dark lava beds are similar in shade of pelage, while pale races occupy the intervening pale soils of the desert plain.

The differentiation of the local populations associated with local soil areas of different shades of color seems best attributable to selection pressure that exceeds the homogenizing effect of interbreeding between the several adjacent, local populations. The local distribution of the cactus-mouse is influenced by its preference for rocky situations, but, at some seasons of the year at least, it ranges more widely over the desert plains than any other primarily saxicolous mammal of the region (Blair, 1943). There is, therefore, incomplete ecological isolation of such populations as those on the two lava beds.

Even the small area of Tularosa red soil is large enough for differentiation in shade of pelage of cactus-mice to occur. Color differentiation of another species, *Peromyscus maniculatus,* on the Tularosa red soil and other soils of the desert plain has previously been reported (Blair, 1947). The Tularosa and Alamogordo stocks of cactus-mice are samples from a continuously distributed population that occupies the front and foothills of the Sacramento Mountains. There must be a fairly continuous interchange of individuals between the mice living on the dark red Tularosa soil and those living on the pinkish gray Alamogordo soil. The small size of the area of dark red soil at Tularosa and the swamping effect of gene dispersal from near-by areas of pinkish gray soils probably account for the relatively high variability of the Tularosa stock. Selection pressure and dispersal pressure evidently more or less balance one another. The selection pressure here seems insufficient to eliminate all or most of the genes making for paleness of shade. The influx of genes from surrounding areas seems insufficient to overcome completely the effects of selection against the genes for paleness.

An interchange of genes undoubtedly takes place between the populations of the Malpais lava and the populations of the near-by mountains, where the background is relatively pale. Benson (1933 : 41) has suggested that the variability of the Kenzin and Malpais lava populations of cactus-mice is due to immigration from surrounding territory. Such immigration and a consequent transfer of genes probably takes place between the other contiguous color populations of cactus-mice in the region. This interchange of genes, without the operation of some kind of selection, would theoretically result in a fairly homogeneous population of cactus-mice throughout the basin. The existence of these color races, therefore, can be explained adequately only as the result of natural selection.

SUMMARY

Cactus-mice in the Tularosa Basin of southern New Mexico usually correspond in shade of pelage to the shade of the background on which they live. Stocks from the Malpais lava in the northern part of the basin and from the Kenzin lava south of the basin are very similar to one another in mean shade of pelage. Relatively pale stocks were taken at Alamogordo and Lone Butte on the pinkish gray soils of the intervening desert basin. The Tularosa stock, which is from a relatively small area of dark red soil is intermediate in shade of pelage between the lava-bed stocks and the stocks from pinkish gray soils. The Tularosa stock, being from a relatively small area of uniform soil color, is more variable than are the other stocks. The existence of the local cactus-mouse populations distinguished by shade of pelage is attributed to selection pressure that exceeds the homogenizing effect of interbreeding between the several adjacent local populations.

LITERATURE CITED

Benson, Seth B.

1933 Concealing coloration among some desert rodents of the southwestern United States. Univ. Calif. Publ. Zool., 40: 1–70, 2 pls., 8 text figs.

Blair, W. Frank

1943 Ecological distribution of mammals in the Tularosa Basin, New Mexico. Contrib. Lab. Vert. Biol. Univ. Mich., 20: 1–24, 1 fig.

1947 Estimated frequencies of the buff and gray genes (G, g) in adjacent populations of deer-mice (*Peromyscus maniculatus blandus*) living on soils of different colors. *Ibid.*, 36: 1–16.

Dice, Lee R.

1932 Variation in a geographic race of the deer-mouse, *Peromyscus maniculatus bairdii.* Occ. Papers Mus. Zool. Univ. Mich., 239: 1–26, 1 fig.

1939 Variation in the cactus-mouse, *Peromyscus eremicus*. Contrib. Lab. Vert. Genetics Univ. Mich., 8: 1–27, 1 fig.

DICE, LEE R., and PHILIP M. BLOSSOM

1937 Studies of mammalian ecology in southwestern North America with special attention to the colors of desert mammals. Carnegie Inst. Wash. Publ., 485; i–iv, 1–129, 8 pls., 8 figs.

Department of Zoology, University of Texas,
Austin, Texas